LAKE MANAGEMENT

lake man·age·ment (lāk man'ij ment), *n.* A broad range of activities conducted to create, protect or maintain a certain desired condition in a lake.

Lake organizations and municipalities can become involved in a substantial range of lake management activities. It's a good idea for some members of your organization to have a basic understanding of various lake management philosophies, techniques and policies. This information can simplify your long range lake planning.

LAKE MANAGEMENT ACTIVITIES

by Carroll Schaal

Some aspects of lake management are highly technical and the realm of agencies, academics and other professionals. But don't be apprehensive; these lake professionals will be glad to assist you. This section describes some of the more common management activities and tells you where to look for expert assistance. Many of the issues surrounding these activities are complex. Before embarking on any project consult a professional and find out more about your specific undertaking. Make sure that everyone living on and using the lake has the opportunity to learn about the project and voice their opinion. Also remember, a conscientious educational program should be a part of any lake management activity. A quality lake management plan needs to include the following components:

- **Long Range Planning**
- **Lake Monitoring**
- **Lake Protection**
- **Lake Restoration (if required)**

For information on funding for various management projects see Section 8 of this Handbook on *Grants* and Section 4 on *Lake Planning*.

Proposed management activities should be based upon goals and recommendations recorded in a thorough lake management plan. This plan needs to be accepted by the lake community. In addition to a general plan, a more detailed plan, called a diagnostic and feasibility study, is often used to fully evaluate the appropriateness and details of a specific management activity. Each lake organization plan will be unique because each lake is distinctive. Therefore a technique that works on one type of lake may not work on another.

Management involving a manipulation of the environment requires careful planning. Many techniques or activities are only appropriate under certain conditions or in specific types of lakes. Remember it is less expensive to prevent a problem than to re-establish previous conditions. If a project is designed to restore a lake (dredging, aeration, alum treatments) the capital outlay required can be daunting.

Lake management often deals with a broad range of issues ranging from water quality to wildlife habitat. Areas of growing concern in lake management involve recreational use conflicts, shoreline aesthetics, and watershed development. Public access may also be of interest for many lake organizations, not only when considering the impact of recreational use on the water bodies but also if you are looking for state funding for lake management projects.

Common subjects of management activities include:

- Excessive aquatic plant or algae growth
- Sedimentation
- Use conflicts
- Fishing
- Freeze outs (winter fish kills)
- Water quality
- Wildlife habitat protection
- Water level changes
- Boating safety
- Shoreline development

ACCESS

As population and development pressure increases on the Badger state's waterbodies, the ability of the public to gain access to lakes and streams has been reduced. Wisconsin law dictates that navigable waters of the state are public resources.

Wisconsin's administrative code covering public access is called NR 1.90-1.93. These rules establish a specific policy for public access to state waterways. It defines standards for determining whether boating access is adequate and establishes priorities for acquiring boating access sites. Following is a description of its major provisions.

Policy

The rule establishes a goal for the state "to provide and maintain reasonable access to the state's navigable lakes, rivers and streams for the public." The rule provides for boating and all other appropriate uses of waterways, and states that waterway uses shall be equally available to all users. For example, the rule entitles general public users of a waterbody to use the same types and sizes of watercraft as riparians. The Department of Natural Resources (DNR) is directed to work with governmental units and citizens to acquire, develop and maintain public access which meets policy objectives. The DNR develops standards for both density and design of public accesses. DNR provides funding and "natural resource enhancement services" of a waterway (such as fish stocking) if reasonable public boating access has been provided. The Department also works to enhance the development of non-boating public access.

Boating Access Standards

Minimum Access to Qualify for Assistance

The rule defines the natural resources enhancement services that the DNR may provide to waterways with adequate boating public access. The rule provides a specific set of standards for determining if boating access to a waterway is adequate. These standards define the minimum number of parking spaces which must be available contiguous with the launch site and describes the required support facilities. The rule also provides for considering privately owned access sites in evaluating access adequacy. Exceptions to the minimum standards are allowed if an alternative access and waterway protection plan consistent with the policy is approved.

Maximum Access Standards

The rule sets maximum access standards. Greater public access will not be permitted or funded unless the need is established in a plan. This provision is designed to help prevent public safety hazards.

Alternative Boating Access and Waterway Protection Plans

The rule allows the DNR to provide resource enhancement services to waterways which do not meet public access standards (either minimum or maximum) if an alternative plan is implemented. The alternative plan, which must be approved by the DNR, must be consistent with protection of public health, safety and welfare, and with the objectives of the rule. This is intended to provide flexibility to tailor the rule application to the specific needs of individual waterbodies.

Recognition of Private Access Providers

The rule specifies that privately owned boating access shall be included in determining compliance with the rule if the launch fee is reasonable, the access meets standards, and the owner provides a contract with the state agreeing to provide access for at least five years.

Design and Construction Standards

Public access sites are being designed to be more environmentally friendly. The rule establishes development standards for boating access sites which will be applied whenever a DNR permit is required. These standards require designs for multiple use and minimization of use conflicts, avoidance of critical habitats and sensitive areas, protection of natural shoreline beauty, and barrier-free access for persons with disabilities.

Fees

The rule uses the resident daily entry fee for state parks and forests as the reasonable base fee for boating access. The rule contains a formula for increasing the base fee to account for extra access features such as paved areas, attendants or large boat parking.

Season passes can't exceed 10 times the daily launch fee, and nonresident fees may not exceed 150% of the resident fee. Fees in excess of the base fee must be approved by DNR if state funding is required.

Access Acquisition Priority

The DNR has a policy of acquiring boating access on important stream systems and lakes of more than 1,000 acres and of pursuing access acquisition on smaller lakes when it is important for recreational activities. High priority for establishing boating access is assigned to: 1) waters without boating access; 2) lakes over 500 acres; 3) streams that do not meet the minimum access standards; and, 4) waters near population centers.

Access Abandonment

The rule provides specific criteria for the DNR's approval of petitions to abandon accesses under Sec. 80.41, Wis. Stats. The rule also includes the requirement that remaining access can not be less than the minimum established by the rule.

Access in Subdivisions

Currently, the DNR has authority to approve modifications to the access requirements in subdivisions which are contained in Sec. 236.16(3), Wis. Stats.

We are fortunate to live in a state where the waters are open and free for all to use in a considerate and courteous manner. Public use of our waterways plays a role in many of the management strategies discussed in this segment.

A WORD ABOUT WATERSHEDS

Surface Watersheds

Most **in-lake** problems originate in the watershed and the effectiveness of in-lake treatments is often dependent upon the stability and control pollution sources in the watershed. For example, algae blooms or excessive plant growth can be driven by excessive nutrients. While some lake sediments can contribute enough nutrients to fuel these problems, the ultimate source is the watershed and until sources in the watershed are controlled, any in-lake management will be ineffective. Therefore, the first step in lake protection is watershed management.

The first step in lake management must be watershed management.

Diagram of a typical watershed.

Watershed management begins with listing existing and potential impacts on the lake and its water quality. This may include a land use inventory, a survey of lake users or making a record of pollution sites (usually nutrients and sediments) such as barnyard runoff, eroding stream banks, sewer discharges, septic systems, parking lots and construction sites to name a few. Once these sources are identified they can be prioritized relative to their impact on the lake. Corrective actions, or best management practices (BMPs), can be applied to the most severe. Essentially, the goal of these BMPs is to prevent, divert or treat high nutrient, sediment laden or otherwise polluted water from coming into the lake.

If the lake doesn't have an existing watershed problem, you're ahead of the game! For lakes with good water quality and sparsely developed watersheds, best management becomes forecasting and managing future growth by putting in place mechanisms for good land use planning. Regulatory development standards that will protect water quality and limit impacts on lakes can be enacted at the local level. Protecting a watershed is far more cost effective than trying to restore one.

Ground Watersheds

Groundwater sounds like an oxy-moron. Is it ground or is it water? One thing for sure, it is probably the least understood of all of Wisconsin's natural resources. Groundwater is water that seeps into the ground and moves between particles of soil and cracks in the bedrock. Because we rarely notice it and its movements are hard to discern, groundwater remains somewhat of an enigma. Often, there is a vital relationship between drinking water, groundwater and lakes. In some lakes, groundwater is the major factor impacting water quality. All seepage lakes are affected by groundwater and groundwater impacts on reservoirs range from minimal to significant. For these waterbodies, the origin and movement of groundwater can determine whether pollutants will be carried into the lake. Restoration of groundwater quality is impossible. The only effective method to assure high quality groundwater is to protect the source.

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You may want to contact the Central Wisconsin Groundwater Center at the University of Wisconsin-Stevens Point (715-346-4270) for assistance in understanding if groundwater affects your lake. Your county Extension agent or DNR lakes coordinator may also be able to assist you. Some of the questions you may ask could include:

- How much ground water is coming into and leaving the lake?

- Where is the groundwater that enters the lake coming from?

- Where are the critical groundwater recharge areas such as wetland and springs and how can they be protected? Groundwater may be coming from the same source as the surface water but there may be differences. Some counties have groundwater elevation maps.

- What type of ground does the water flow through (aquifer)? You could find this information and the general depth to groundwater in the area from well construction reports.

- What are the land uses in the groundwater watershed?

Once you have the area outlined you can check land use maps at the county planning and zoning office if they have them. Then you can check for land uses that could threaten groundwater quality, and potentially affect the lake. These uses could include landfills, manure piles, discharges from industry or agriculture, sewage, underground chemical storage tanks and pipelines.

Actions you can take to deal with potential groundwater pollution problems:

- Educate
- Lobby local officials for local regulations or zoning changes
- Request agencies to enforce applicable laws

Actions we can take to protect groundwater quality:

- Use less lawn fertilizer. It can reach the lake through groundwater as well as runoff.
- Inspect and maintain septic systems.
- Properly abandon wells. Abandoned wells can allow contaminants to enter groundwater more easily.
- Check underground storage tanks. Tanks can leak into groundwater and then into the lake.
- Limit the burning of trash. Plastics can contaminate groundwater even when burned in a barrel. The debris goes up in the air and then redeposits on the ground downwind.
- Recycle used oil, antifreeze, household chemicals, batteries, etc., rather than dumping them.

Runoff Pollution

Non-Point Source:

Pollution can be defined as the act of making something unpure, unclean or contaminated. Since the advent of the Clean Water Act in the early 1970s this nation has made a major and fairly successful effort to clean up water pollution originating from a **point source**. A point source is defined as pollution coming from a single source, such as an industrial outfall pipe or the pipe from a city sewage system. The other major source of water pollution is much tougher to deal with because it may require changes in some of our life habits. This runoff or **non-point source** (NPS) pollution is caused by normal day-to-day human activities. Cleaning up this pollution runoff is the focus of significant management efforts throughout the United States and here in Wisconsin.

Below is a list of best management practices used by the State of Wisconsin in its Non-point Source Pollution Abatement Program. Through this program technical and financial assistance for watershed management is available. However, to obtain this assistance, a watershed must be designated as a state priority. Lake organizations should work with their county land conservation departments and DNR district water resources manager to find out if their watershed is eligible. The Wisconsin DNR offers excellent grant programs which can be used to accomplish many of these objectives.

Wisconsin Best Management Practices
(from NR 120)

Cropland Practices:
- Change in crop rotations
- Change from cropland to grassland
- Contour cropping
- Strip cropping
- Field diversions
- Terraces
- Grassed waterways
- Reduced tillage
- Nutrient management
- Pesticide management

Cropland, Urban and Other Area Practices:
- Critical area stabilization
- Grade stabilization structures
- Shoreline and streambank protection (including fish structures)
- Shoreline buffers
- Wetland restoration
- Livestock exclusion from woodlots
- Well abandonment

Animal Waste Management Practices:
- Manure spreading management
- Barnyard runoff management
- Animal lot relocation
- Manure storage facilities
- Roofs for barnyard runoff management and manure storage facilities
- Manure storage ordinances

Urban Practices:
- Street sweeping
- Leaf collection
- Pet waste ordinances
- Construction site erosion control ordinances
- Infiltration basins
- Infiltration trenches
- Porous pavement
- Grassed swales
- Wet basins
- Detention basins
- Wetland basins
- Covering materials being stored

Shoreland Restoration

The shallow areas near shore are called the **littoral zone**. These highly productive habitats provide spawning areas and fish nurseries. The aquatic plants in these areas shelter fingerlings and the zooplankton needed as food. The plants growing in the littoral zone increase the uptake of nutrients and reduce wind/wave action that can erode shorelines and stir up sediments causing turbidity. Safeguarding these areas from excessive plant removal is fundamental to maintaining a healthy lake.

Buffer Strips:

Shoreland areas suffering from some sort of disturbance are good candidates for restoration. This may involve the replanting of lost native vegetation and possibly the repair of active shoreline erosion sites with additional plantings or rock. Such projects require careful evaluation by a professional to determine the proper mix of species and planting procedures.

The upland part of the shore is important too. The riparian area near the water's edge may support 500 times the diversity of plant and animal species of comparable upland sites. Vigorous vegetation along and above the banks acts as a buffer zone to slow nutrients

and other pollution in stormwater runoff, while providing erosion control. Shore edge vegetation screens human activities and aids fish and wildlife habitat by providing shade and supporting insect life (fish food). It also adds to the lake's natural beauty. Encouraging and providing incentives to riparian property owners to retain and replant shoreland buffers is a worthwhile restoration activity. Encouraging individuals to reduce or end fertilizer use on their lawns and working to enforce shoreland zoning requirements are good protection and prevention management approaches.

IN-LAKE MANAGEMENT ACTIVITIES

Lake Monitoring

There is a saying that "you can't manage what you can't measure." An essential element of good lake management involves recording changes or trends in the water quality of a lake. The quality of any planning or management activity will be largely determined by the amount of data available about the lake.

> ***You can't manage what you can't measure.***

One of the most popular and impressive programs available to lake organizations is Self-Help Lake Monitoring. This volunteer alliance between involved citizens and the DNR was inaugurated in 1986 and is the core of Wisconsin's lake partnership with over 800 volunteers participating statewide. The assistance and enthusiasm of local volunteers has played an important part in lake monitoring and protection.

Monitoring can range from simple measurements of water clarity to a variety of chemical analyses—looking at nutrients, temperature, and oxygen levels. Sampling procedures vary from using a Secchi disk to measure water clarity to capturing water in a sample bottle and sending it to a lab for study.

Monitoring may involve collecting and analyzing water samples, measuring inflow and outflow and local rainfall. Important sample sites include the deepest portion of the main lake basin and major tributaries coming into and leaving the lake. Lake sampling develops a **profile** or a series of samples and recordings taken at various depths over time to track how the quality of the lake changes through the season. The flow or amount of water coming into and leaving the lake can be monitored at the inlet and outlets to help determine the rate at which water is exchanged. Water quality samples may also be taken to help determine the impact the watershed has on the lake water quality.

The type of monitoring data needed depends upon the management needs of the lake. A lake with a serious water quality problem embarking upon a major study to determine the cause may require a detailed monitoring plan, perhaps going beyond the realm of the Self-Help Lake Monitoring Program. On the other hand, Secchi disk readings may be adequate for providing early warning of changing trends for a lake interested in protecting its good

water quality. Check with your DNR district lake coordinator to determine the appropriate level of monitoring for your lake. A good place to begin is with Self-Help Lake Monitoring.

Aquatic Plant Management (APM)

Aquatic plants appear in many shapes and forms. Some are microscopic in size while others are immense, growing over 30 feet tall. Some have showy flowers while other provide the homes and food for unique critters. The role of aquatic plants in a lake or river is similar to that of trees and shrubs in a forest... without them little else would exist.

One of the concerns voiced about lakes is an overabundance of aquatic plants in the shallow areas. Aquatic plants can be a nuisance when they obstruct swimming and boating activities, but they also work naturally to improve water quality while providing vital fish and wildlife habitat.

Excessive plant growth can usually be tied to enrichment or a **loading** of nutrients (phosphorus and nitrogen) into the lake. A sound program to control incoming nutrients should be a part of any aquatic plant management strategy. The first step toward lake management is to evaluate the severity of the problem and establish the need for active measures. **Your DNR district lake coordinator can assist here.** They will assist you in evaluating your lake's plant community and developing a plan. If it is determined that a serious but controllable nuisance problem exists, there are several management options. Before embarking upon a whole-lake or large-scale plant control project, a lake-wide evaluation of the plant community is advisable. From this evaluation you can develop a map of areas where plant removal is applicable and other areas where disturbance is not appropriate. The plan will inform individuals of protected areas and help protect environs for fish habitat, spawning areas and rare or otherwise beneficial stands of plants. To develop a sound plan, involve the appropriate people. Professionals such as wardens, wildlife experts, fisheries personnel, zoning and regulations people and lake users that will be affected should be on the list.

Harvesting:

Once a plan is in place and you have decided that some aquatic plants need to be removed, the most widely recommended and preferred management option is harvesting and the physical removal of the plants causing the nuisance. Large-scale lake-wide harvesting is normally done with a floating mechanical cutter or harvester. Cost-sharing for the purchase of mechanical harvesters is available from the Department of Natural Resources to qualified lake organizations and municipalities that have developed an aquatic plant management plan.

Harvesting can provide a temporary solution to an overabundance of rooted and some floating aquatic plants. Mechanical harvesting can be used to provide boat lanes for reaching deep water and moving between areas on a lake, or for keeping areas clear for waterskiing. Sometimes plant removal can improve fish habitat by creating cruising lanes and increasing

edge-effect—the interface between plant beds and open water—which can benefit larger game fish.

Harvesting machines operate best in open areas where water is two to six feet deep. Prior to harvesting map out sensitive sites, such as spawning areas or beds of beneficial plants, and avoid them. Shorelines should not be cut except to allow pier access or maintain public swimming areas. Hold off harvesting until mid-June to avoid fish spawning. Harvesting will probably need to be done twice during the season. Removal of plant matter from the lake can help remove nutrients. However, improvement in water quality will not result from harvesting alone.

Aquatic plant harvesting is not always the best management tool. Too much or inappropriate harvesting can disrupt the base of a lake ecosystem, harming fisheries and diminishing water clarity. Be aware that harvesting does not control swimmers itch or algae blooms. Mechanical harvesting is an expensive undertaking with machines costing from $25,000 to over $100,000. In addition to basic operation, maintenance and plant disposal costs, you will need a method to transport plant materials away and a site for access and storage of the equipment.

Harvested plants are a valuable resource, but because they are high in nutrients, state law (Sec. 30.125, Wis. Stats.) requires disposal away from the lake shore area. Usually they are readily accepted by farmers and gardeners as soil amendments but disposal logistics must be considered.

For small sites and areas around residences and piers, removal of aquatic plants by hand is less complicated. There are a variety of rakes, scythes and other tools available commercially to support a small manual harvesting operation.

Bottom Barriers:

On small sites an alternative to harvesting is a bottom barrier or plant screen. These are various types of fabric sheets laid down over the lake bottom to prevent sunlight penetration and create a physical barrier to plant growth. Properly installed, they are an effective non-toxic approach to plant control. However, they can be difficult to install, as well as hard to move and keep in place. **A permit from the DNR is required before placing aquatic plant screens.**

Herbicides:

Chemical herbicides can be used to control nuisance plants but the consequences of their use is not well understood. These herbicides are poisons and may kill more than the target plants leaving a site more susceptible to regrowth and expansion of exotics like eurasian water milfoil. **Pesticide use in lakes is regulated by the DNR under Wis. Administrative Code NR 107. Permits are required.** The use of chemicals to control aquatic plants should only be used for very localized and intense nuisances where other

control solutions are not practical. Contact your DNR district lake coordinator and discuss the pros and cons of chemical applications.

Aeration/Artificial Circulation:

Aeration is a method of pumping air into the lower level of a lake causing it to mix as the bubbles rise to the surface. The success of this sometimes controversial lake management tool can be unpredictable. Aeration systems are fairly sophisticated and can be expensive. The procedure requires the placement of pipe on the bottom of the lake and a pump house or equipment to pump air through the pipes. **A permit is required to place any structure on the bottom of a Wisconsin lake.** Contact your local DNR water regulation and zoning specialist.

Aeration systems have been used on large lakes but are most often used on small lakes or ponds. Aeration is used in some lake management plans to prevent winter fish kills. In the winter water temperatures are the reverse of summer time. Water directly under the ice is colder than water near the lake bottom. By circulating the lower warmer water to the top, ice formation is prevented allowing absorption of oxygen from the atmosphere and possibly a minor amount of oxygen absorption through the bubbles.

A lake organization that is using aeration would be well served to carry liability insurance. During the winter, aeration will keep the lake open or there will be thin ice conditions creating a potential hazard to winter lake use. **Your DNR water safety specialist can advise you on the required method to mark the area.**

On some lakes aeration is attempted to limit phosphorus entering the water from sediments. In the summer, aeration prevents a lake from stratifying or separating into layers which prevents the cooler bottom water from mixing with the warmer surface water. When this layering happens, the lower water may lose oxygen which not only limits space for the fish, but can also draw phosphorus out of the sediment, which may fuel algae growth. Preventing stratification limits oxygen depletion and keeps the phosphorus in the sediments. Success of this management strategy is highly variable from lake to lake. In some cases water quality has decreased as a result.

If you are considering aeration, contact your DNR district lake coordinator. They can assist with an evaluation of the particular condition of your lakes and advise you on the best management path to take. Aeration systems need to be thoroughly evaluated and designed by experienced professionals. Systems can cost from a few thousand to tens of thousands of dollars to build and entail continuous electrical costs, maintenance and insurance.

Nutrient Inactivation:

If you have done all you can do in the watershed and your water quality is getting worse or the sediments are getting deeper, alum treatment or dredging are possible options. You have now entered the realm of major league lake management. Depending on the size of the area to be treated, costs, equipment and the technology needed can be significant. **Necessary permits must be obtained from the Department of Natural Resources.** Detailed plans should be developed with your consultant and the DNR.

Alum Treatment

When lake sediments are determined to be a source of in-lake nutrients, a proven alternative to dredging is the use of chemicals, often aluminum sulfate (alum) or other compounds, to inactivate the lake's available phosphorus. Properly spread over the lake, the alum should bind with the phosphorus in the water and sink it to the bottom. If enough is used, it should create a layer on the bottom effectively sealing the sediments and preventing phosphorus from being released.

This technique is not effective in shallow lakes where bottom sediments can be easily stirred up or in reservoirs or lakes with large unstable watersheds where water and sediment is rapidly being added and exchanged. Precautions are needed for soft water lakes where high dosages of alum may become toxic to aquatic life.

Thousands of pounds of alum may need to be applied in a labor-intensive treatment. While it is expensive (costs can run over $200-$300 per acre), it is generally less costly than dredging. Treatments should be designed to last ten years or more in lakes with well-managed watersheds. Good watershed management and a detailed diagnostic and feasibility study are required.

Dredging

Dredging to remove sediment from a lake bottom is one of the most expensive and potentially environmentally damaging management activities. Dredging activities rarely receive public funding except for opening navigation channels. It usually involves a floating barge with a hydraulic cutter that sucks and pumps a slurry of sediment through pipes to an on-land de-watering site. Once dried, the material is spread on an upland site or land-filled. Backhoes or clamshell buckets on cranes operating from shore or the drained lake bed are also used for smaller scale projects.

Dredging is conducted to control algae, aquatic plants and to open navigation channels. Removing a layer of nutrient-rich sediments may reduce internal cycling that fuels algal growth. Dredging shallow areas below the limit of sunlight penetration can control aquatic plant growth. Dredging is also suitable for removing dangerous obstructions or deepening areas to create safe navigation near boat launch facilities and access channels.

Dredging should be regarded as a temporary solution that will probably have to be repeated routinely to maintain its effect. It is usually only practical to remove a few feet of material over a large area, so dredged lakes will remain susceptible to filling back in rather quickly. A thorough watershed management program to control incoming sediment should be in place before dredging is considered. Reservoirs and drainage lakes with large watersheds are poor candidates for dredging since it is usually impossible to control the incoming sediment load.

The cost of dredging varies greatly from site to site. A major portion of dredging costs goes toward planning, permitting and disposal of the spoils. A site large enough to stock the spoil material while it de-waters should be close to the operation. Dried spoils are permanently disposed of by trucking to an upland site or to a landfill if the spoils are contaminated. Water draining from the site will need to be discharged back into the lake or a stream and may be high in nutrients and possibly other contaminants. The water returning to the lake or a stream will be required to meet water quality standards. A thorough diagnostic and feasibility study is required to properly plan for a dredge operation and to satisfy discharge permit requirements.

Fish Management

How's the fishing? Often lake organization deal with membership concerns for better or different types of fishing. Fish stocking is done to respond to these angler demands.

Success of fish stocking programs are variable and often only temporary. Fish management should consider biodiversity and the development of a sustaining fishery as desirable goals. Your DNR area fish manager can help you develop a plan and determine the feasibility of stocking. Careful study is needed to ensure prevailing conditions in the lake are favorable to introduction of fish stocks. **A permit is required for stocking any fish and can be obtained from your local DNR fisheries manager.**

Improving or creating habitat is a key to a successful lake fishery. Activities such as restoration of wetlands, shorelands and near-shore areas and the installation of fish cribs, artificial reefs or other structures are some common methods of enhancing fish habitat. A good aquatic plant management plan is also a benefit to fish habitat improvement and protection. **Placing structures in water requires a permit from the DNR.**

Fish stocking is not always effective. Predation by larger fish, exotics, a limited food supply or heavy fishing pressure can decimate a planted fish population. You may want to note that public access is required for DNR-sponsored fish stocking but is not needed for private stocking.

Algal Control with Fish:

In some lakes the fishery may be managed to help control algal growth. In shallow lakes it is possible that a major source of nutrients contributing to algal growth results from the high densities of bottom feeding fish such as carp, which stir and suspend nutrient-rich sediments. Carp eradication efforts, using poisons that kill off all the lake's fish, and restocking with game fish can be part of a lake improvement strategy. Large scale seining and commercial harvesting operations have also been used, but with less success. After eradication, barriers on tributaries are installed to prevent carp reintroduction. With luck, the invigorated game fish population will be able to maintain dominance over any future invaders.

High densities of pan fish can deplete a lake of zooplankton (the tiny creatures that feed upon algae). Stocking large game fish to prey upon the pan fish population may stimulate recovery of zooplankton so they can reduce certain types of algal growth.

Draw Downs

Some lakes and all flowages have water levels controlled by dams. Changes in water levels can have dramatic effects on lake use and management.

When lake water levels are determined by a dam with an adjustable control structure, the act of lowering the water level is called a **draw down**. It is an inexpensive and effective management activity that can be used to control vegetation in shallow areas and support other management activities such as protecting shorelines over winter. Growth of some species of plants is increased while other types are killed off by the temporary lack of water. Careful evaluation by a trained professional is required to find out how a particular lake's vegetation may respond to a draw down. To be effective for plant control draw downs need to extend over winter so that the exposed sediments freeze as well as dry out. Loose mucky sediments may also be compressed during draw down providing small improvements in depth and water clarity after refilling. Draw downs can provide a good opportunity to carry out shoreland reconstruction projects, fish management or dredging activities.

While relatively easy to do, drawing down a lake's level may upset some individuals and can generate controversy. Doing a good job of providing information and education prior to the project makes sense. In some cases draw downs can damage shorelines and impact some sensitive species of plants and animals. A well thought out draw down plan is important. **A permit from the DNR is required for most draw downs.**

Dams

Dams are a common feature of Wisconsin's rivers and streams. These structures range from crude earthen types designed by beaver or early loggers to very sophisticated concrete and steel power dams holding back miles of water. Some people are not aware that the lake, pond or flowage they live on is actually a dammed stream.

One of the functions of a river is to carry sediment and debris downstream. When a stream is dammed the velocity of the water slows and particles of dirt, debris and nutrients settle to the bottom. Over time they can add many feet of sediment to the bottom. This shallow, nutrient-rich **lake bed** is a perfect place for aquatic plants to grow.

Dams are designed to benefit society but in some situations, or when improperly used, the immense energy of the water stored by the dam can be a considerable hazard. Dams can obstruct fish migration and spawning. Dams, especially those stopping small impoundments and mill ponds, are commonly removed or modified to limit these detrimental effects.

Operations, Maintenance and Repair:

If your organization buys property with a dam located on it they must show financial ability to maintain the dam. **The DNR requires a permit to transfer ownership of dams on navigable streams.** These requirements apply to properties where concrete or metal water level control structures are located and to those containing any related earthen dikes. Both buyer and seller must cooperate to complete permit applications. Realtors, attorneys and lenders must advise their clients of these requirements. If dam transfer requirements are not met, the real estate sale may be void. It's a good idea for a lake organization to retain legal counsel when purchasing any property.

DNR dam transfer requirements help ensure that each dam has a responsible owner to maintain and operate the dam safely in an environmentally sound way.

To obtain a transfer permit, the buyer must generally show:

- all ordered repair work is assigned to seller or buyer;
- financial ability to maintain the dam for at least 10 years;
- acknowledgement of dam operating orders (levels and flows);
- ownership or flowage easements for lands which will be flooded; and
- any construction easements required for access to the dam.

Dam owners or prospective buyers may be reluctant or unable to pay for repair and maintenance of a dam and may be eager to either abandon the dam or transfer it to anyone who will take it. A lake management district may be formed to finance dam ownership, repair and maintenance. If a buyer does not want a dam, the seller should apply to the DNR for a permit to abandon it. A public hearing can help to determine if the dam is worth keeping and may identify a party willing to own and maintain it. If the DNR grants a permit to abandon a dam, the flowage must be gradually drawn down and all water level control structures and dikes must be removed from the stream channel and floodway. This sort of removal can be very expensive.

Before purchasing a dam, you must prove that you can pay for the following during at least a 10-year period: cost of current repairs; annual maintenance; and cost to repair or rebuild the dam in the event of a major flood.

For dams less than six feet high or impounding less than 15 acre feet (equivalent to 15 acres of water one foot deep), DNR engineers will estimate the costs involved in dam repair or maintenance. For larger dams, the buyer or seller must provide estimates. Both public and private buyers may be asked to demonstrate financial ability.

Modeling

We live in the computer age. These machines have found a role in nearly every aspect of our lives. The computer is also used in managing lakes. Computer modeling allows us to predict the impact of various events on our lakes. Experts can develop computer models that anticipate the effects of farming or development on water quality or calculate the change in water quality if nutrients are removed.

Mathematical models are used to represent each lake's unique water and nutrient budgets. They can diagnose problems and predict changes resulting from a proposed management activity. There are various levels of sophistication, each one requiring a more intensive level of monitoring data. If you are interested in learning more about computer modeling, give your DNR district lake coordinator a call. They can assist in linking you with the right people.

REFERENCES

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GLOSSARY

Aerobic: Describes life or processes which require the presence of molecular oxygen.

Algae: Sometimes small but not always. These non-vascular aquatic plants occur as single cells, colonies, or filaments. Planktonic algae float freely in the open water. Filamentous algae form long threads and are often seen as mats on the surface in shallow areas of the lake.

Anaerobic: Describes processes that occur in the absence of molecular oxygen.

Anoxia: A condition of no oxygen in the water. Often occurs near the bottom of fertile stratified lakes in the summer and under ice in smaller lake.

Decomposition: The transformation of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Drainage lakes: Lakes having a defined surface inlet and outlet.

Epilimnion: Uppermost, warmest, well-mixed layer of a lake during summertime thermal stratification. The epilimnion extends from the surface to the thermocline.

Eutrophic: From Greek for "well-nourished," describes a lake of high photosynthetic activity and low transparency.

Eutrophication: The process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation of a lake or reservoir. If the process is accelerated by man-made influences, it is termed cultural eutrophication.

Limnology: Scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes. Also termed freshwater ecology.

Littoral zone: That portion of a water body extending from the shoreline lakeward to the greatest depth occupied by rooted plants.

Macroinvertebrates: Aquatic insects, worms, clams, snails, and other animals visible without aid of a microscope which may be associated with or live on substrates such as sediments and macrophytes. They supply a major portion of fish diets, and consume detritus and algae.

Macrophytes: Rooted and floating aquatic plants, commonly referred to as waterweeds. These plants may flower and bear seed. Some forms, such as duckweed and coontail (*Ceratophyllum*) are free-floating forms without roots in the sediment.

Nutrient: An element or chemical essential to life, including carbon, oxygen, nitrogen, phosphorus, and others.

Nutrient budget: Quantitative assessment of nutrients (e.g. nitrogen or phosphorus) moving into, being retained in, and moving out of an ecosystem; commonly constructed for phosphorus due to its tendency to control lake trophic state.

Oligotrophic: From the Greek "poorly nourished." Describes a lake of low plant productivity and high transparency.

Plankton: From the Greek "wandering" the microscopic plants and animals found floating and drifting in bodies of fresh water and the ocean. The animals are called zooplankton and plants are called phytoplankton.

Secchi depth: A measure of transparency of water obtained by lowering a black and white, or all white, disk (Secchi disk) into water until it is no longer visible. Measured in units of meters or feet.

Seepage lakes: Lakes having either an inlet or outlet (but not both), and generally obtaining their water from groundwater and rain or snow.

Sediment: Bottom material in a lake that has been deposited after the formation of a lake basin. It originates from remains of aquatic organisms, chemical precipitation of dissolved minerals, and erosion of surrounding lands.

Stratification: Layering of water caused by differences in water density. Thermal stratification is typical of most deep lakes (greater than 20 feet) during summer. Chemical stratification can also occur.

Swimmers itch: A rash caused by the skin penetration of the immature stage (cercaria) of a flatworm. The itch is not easily controlled due to complex life cycle of the flat worm. A shower or alcohol rubdown should minimize penetration.

Thermal stratification: Lake stratification caused by temperature-created differences in water density.

Thermocline: A horizontal plane across a lake at the depth of the most rapid vertical change in temperature and density in a stratified lake.

Watershed: Drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.